

Figure 3-4  
El Florido Water Treatment Plant Flow Diagram – Module 1

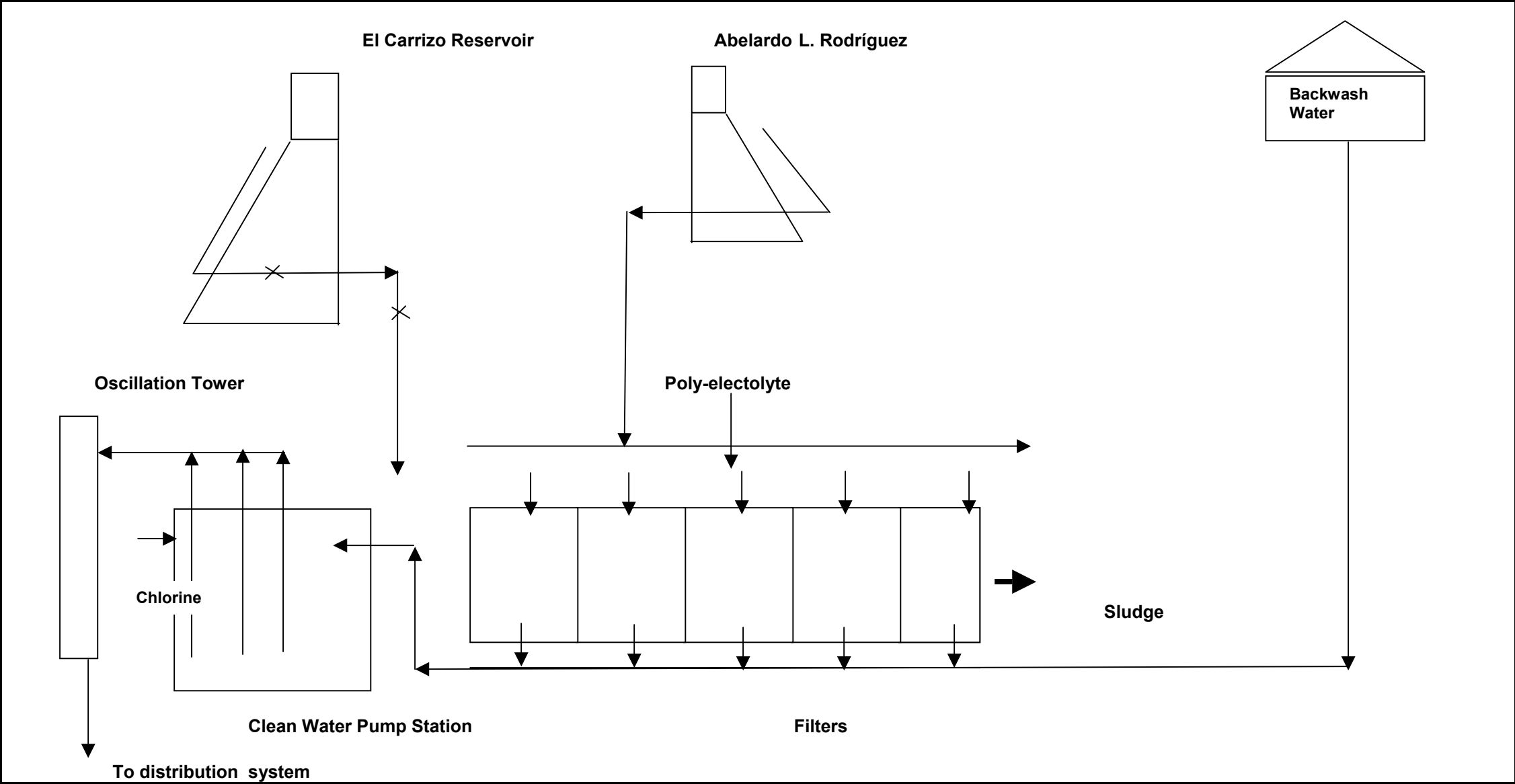


Figure 3-5  
El Florido Water Treatment Plant Flow Diagram - Module 2

Table 3-4 Design Criteria for the EI Florido Plant			
Operation Starting Year		Module 1 1982	Module 2 1982
Type of rapid mix Quantity Mixing Intensity		Pipeline turbulence 1 Low	
Type of flocculator and settler Quantity Flow per unit Tank Area Tank Volume Detention Time	l/s m <sup>2</sup> m <sup>3</sup> Min	Super-pulsator 4 500 282.75 1,130 37.7	None
Type of filters No. Filtration Rate Filtration Rate with one filter out of operation Filter area Type of filter media Depth Uniformity Coefficient Type of Backwash	m <sup>3</sup> /m <sup>2</sup> /d m <sup>3</sup> /m <sup>2</sup> /d m <sup>2</sup> Cm Mm	Constant Rate Filter 12 254 279 56.25 Monomedia sand 140 1.0 Air and water	12 240 262 60 Monomedia sand 80 Air and water
Backwash Pumps		2 in operation, 1 in reserve	2 in operation, 1 in reserve
Blower		1 in operation	1 in reserve
Storage of Treated Water, No. of Reservoirs Capacity Theoretical Detention Time at the plant Baffles	m <sup>3</sup> Min	1 1500 12.5 No	1 1500 12.5 No
Backwash Recovery: Type No. No. of backwashes per day Average volume per filter Total Volume	m <sup>3</sup> m <sup>3</sup>	Rectangular Sedimentation Tank 1 with 4 individual chambers 3 140 420	
Type of sludge management No.		Drying Beds 4	
Chemicals Chemical Use Dose Type of feeder equipment  No. Capacity Storage No. of days at average flow Chemical Use Dose Type of feeder No. Capacity	PPM    m3  PPM	Cationic Polymer / Primary Coagulant 5.10                      2.70 Diaphragm Pump/3/90 6pH=340 l/h/1.75 and 2.5 3 90 gph=340 l/hr 1.75 2.5 Chlorine / Pre-Oxidant Disinfectant 5.1                      2.7 Chlorine Gas 1 XX	

Table 3-4 Design Criteria for the El Florido Plant			
		Module 1	Module 2
Operation Starting Year		1982	1982
Chemical Use	PPM	Chlorine / post chlorination	
Dose		1.2	1.2
Type of feeder		Chlorine Gas	Chlorine Gas
No.		1	1
Capacity		2,000 lbs/24 hrs	2,000 lbs/24 hrs
Storage		12 cylinders of 908 kg	
Average No. of days of flow		XX	
Source: Subdirección de operación y mantenimiento, Potable Water Department, CESPT 2001.			

### ***Quality of Water Treated***

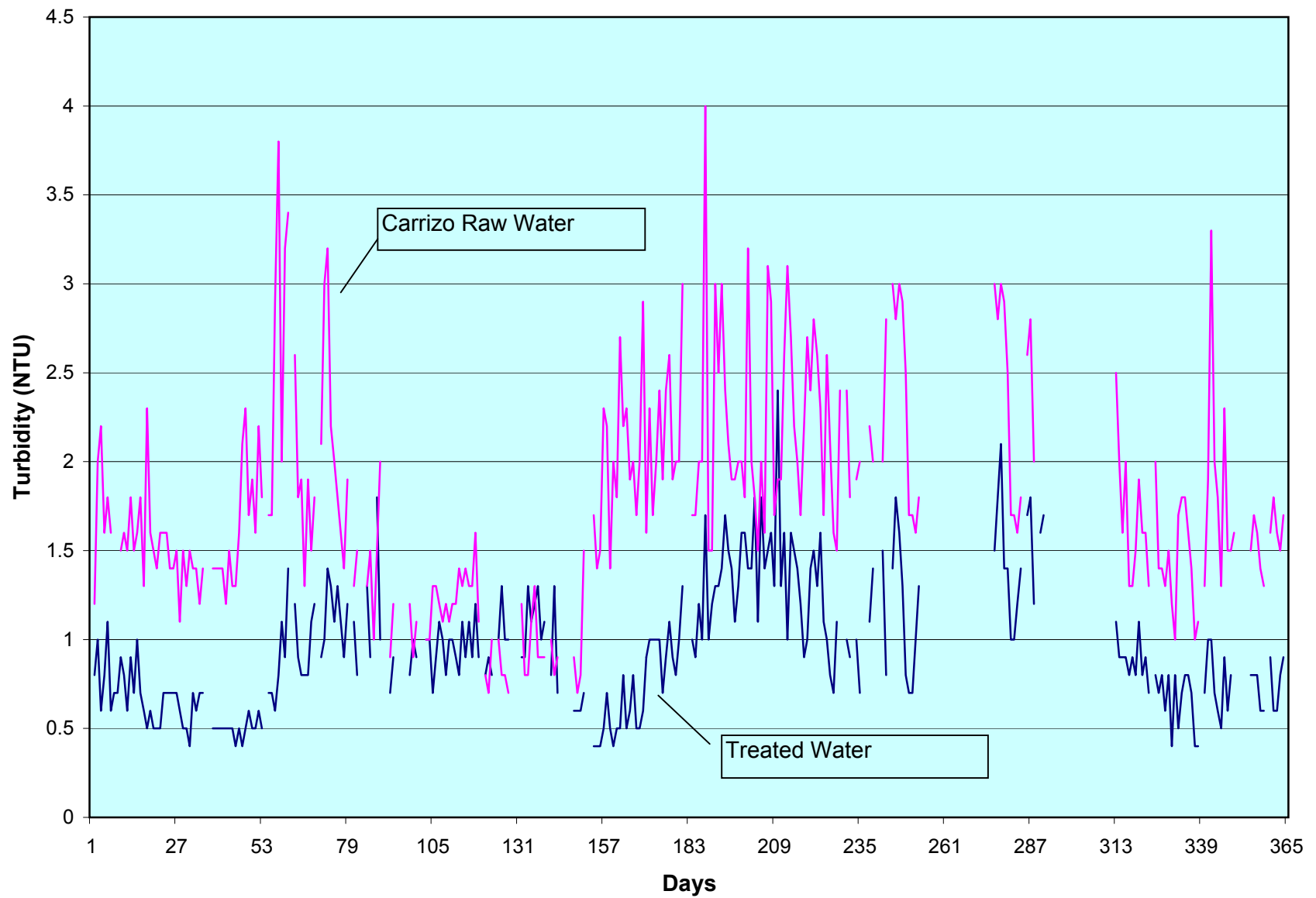
Turbidity is a parameter that is commonly used to indicate the efficiency of a treatment plant. Figures 3-6 and 3-7 show the daily turbidity in the effluent of the two modules of the El Florido Water Treatment Plant for the year 2001, as well as the turbidity of the influent from the El Carrizo Reservoir. Figure 3-8 shows the combined effluent as a percentile distribution. The results show a significant variation in the turbidity of the filtered water in both modules and that the modules achieve a turbidity level of 1.5 NTU or less 95 percent of the time. In addition, it should be noted that the turbidities of the effluent were not documented for 100 days during the year 2001 (Information provided by the Subdivision Office of Operation and Maintenance, Potable Water Department, CESPT 2001).

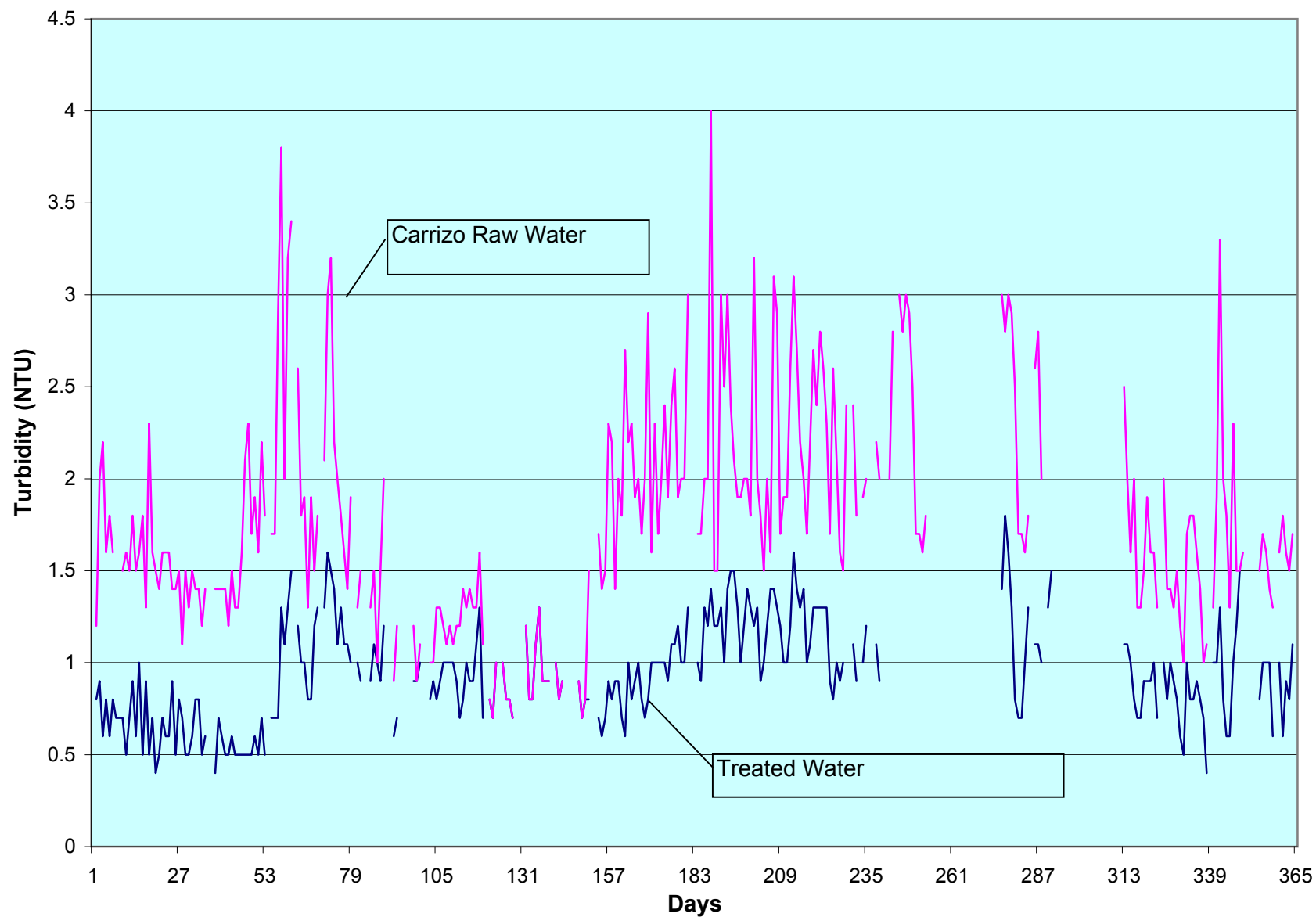
It is important to note that the Mexican standards establishing the maximum permissible turbidity limits for potable water are not a useful gage for the evaluation of current plant performance and what could theoretically be obtained. The maximum permissible limit for turbidity is 5 NTU, but the quality of the influent to the plant is typically half of that concentration. That is, most of the time the raw water would comply with the regulations even without treatment.

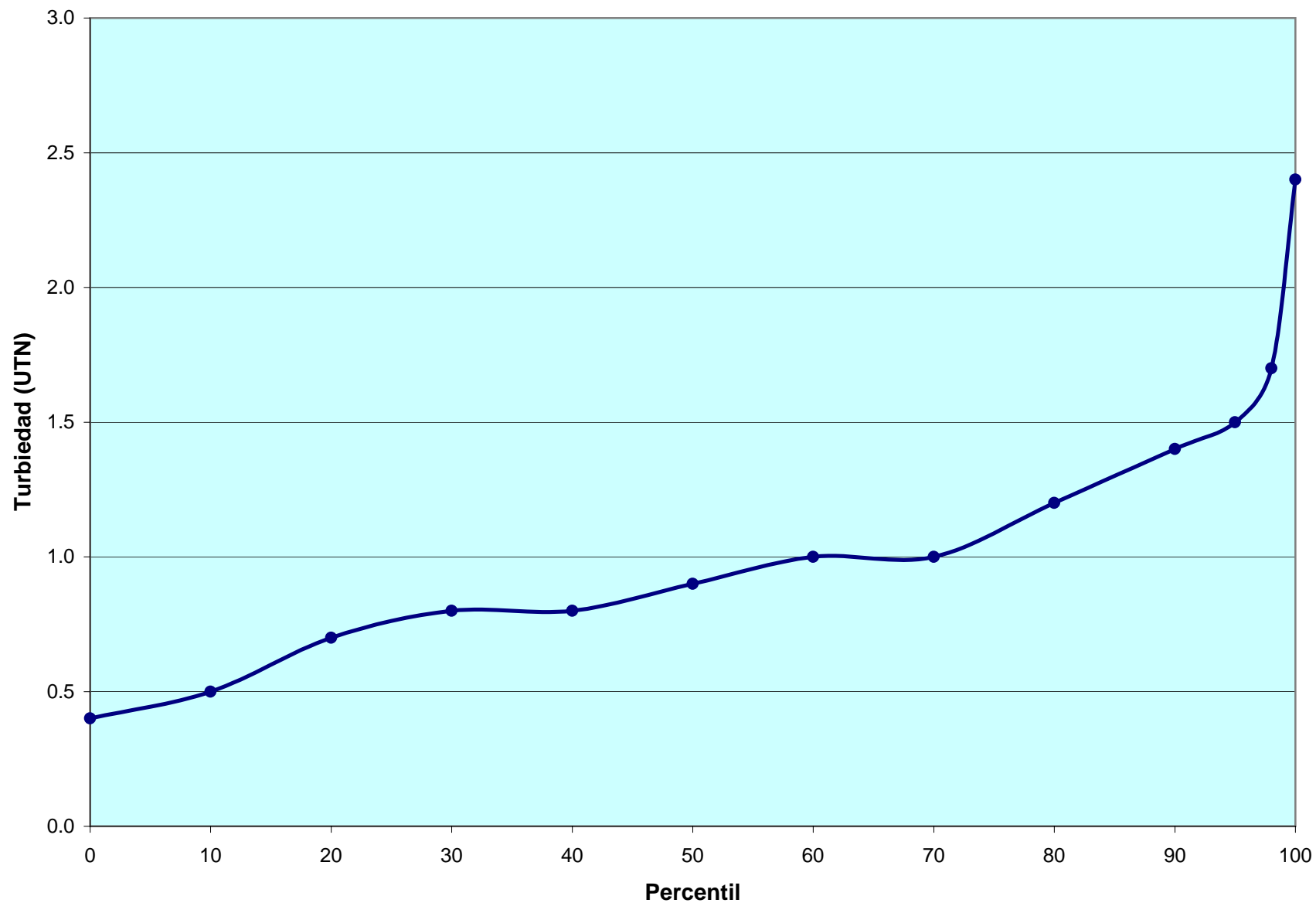
Experience from other places shows that the water from the Colorado River could be efficiently treated so that it would achieve turbidities of less than 0.5 NTU, 95 percent of the time, without significantly increasing treatment costs. We recommend that CESPT consider treated water turbidity goal of 0.5 NTU, to improve the protection of public health.

It is important to note that turbidity is an indicator of the level of particles present in the water, and the turbidity in the treated water is utilized as an indicator of the possible presence of other contaminants that can be removed through physical and chemical processes, such as bacteria, viruses and protozoans. The principle goal of pretreatment and filtration is to efficiently eliminate these particles, and by doing so, to remove other types of contaminants as well.

The efficiency of the filtration process can be improved through optimizing the process, as will be discussed in Section 7.







### **Disinfection**

The effectiveness of disinfection while exiting the plant is frequently measured based on the quantity of residual chlorine in the water after a determined contact time. The most resistant pathogens to disinfection are *Giardia* and viruses, so their inactivation is a good measure of the efficiency of disinfection. In order to determine the level of inactivation achieved, the product of the disinfectant residual and the actual contact time must be calculated. In theory, the detention time of each one of the two modules is approximately 12.4 minutes for the design capacity of the plant 46 mgd (2 m<sup>3</sup>/s per module). Nevertheless, due to the short circuits that happen during operation, the actual contact time is approximately 4 minutes (which is approximately 30 percent of the theoretical detention time, considered typical for tanks without baffles). The free available residual chlorine in the water at the outflow in the year 2001 was approximately 2.6 mg/l, with a minimum observed value of 1.75 mg/l. nonetheless, these values do not represent the quantity of residual chlorine in the distribution network or household delivery points, given that the latter are the control points to evaluate the effectiveness of the disinfection. Based on that, the product of residual chlorine and actual contact time would be approximately 8.8 mg/l-min, representing less than 0.5- log of inactivation for *Giardia* and more than the 4-log of inactivation for viruses. Although the free chlorine is used as a pre-oxidant, the minimum contact time in both modules does not provide a sufficient amount of disinfection.

There is no specific regulation in Mexico for the inactivation of certain microorganisms. In the United States for example, there is a minimum removal requirement of 3-log (99.9 percent) for *Giardia* and 4-log (99.99 percent) for viruses. As has been previously mentioned, the overall operations of the plant could be improved if there were additional storage in order to reduce the frequent flow variations. This additional storage would also provide the benefit of improving disinfection.

Other important steps that would improve disinfection include having on-line redundant or backup feed equipment that can be quickly changed if the operating unit were to fail; continuously monitoring the finished water chlorine residual to avoid periods when disinfection is not achieved. The latter would include a detector with an alarm to warn when the concentrations of residual chlorine are below the acceptable minimum.

### **Abelardo L. Rodríguez Water Treatment Plant**

This plant was designed in 1971 for a flow of 7.5 mgd (330 l/s). In 1980 the plant was modified to increase its capacity to a volume of 14 mgd (600 l/s) and up to 17 mgd (750 l/s) with direct filtration. The plant has been operating since 1975 with a flow that varies between 0 and 12 mgd (0 and 550 l/s). Figure 3-9 presents a process schematic of the plant.

Water flows by gravity from the reservoir to the plant through a 36-inch (915 mm) diameter PVC pipeline. This pipeline includes a flow control valve and flow measurement device.



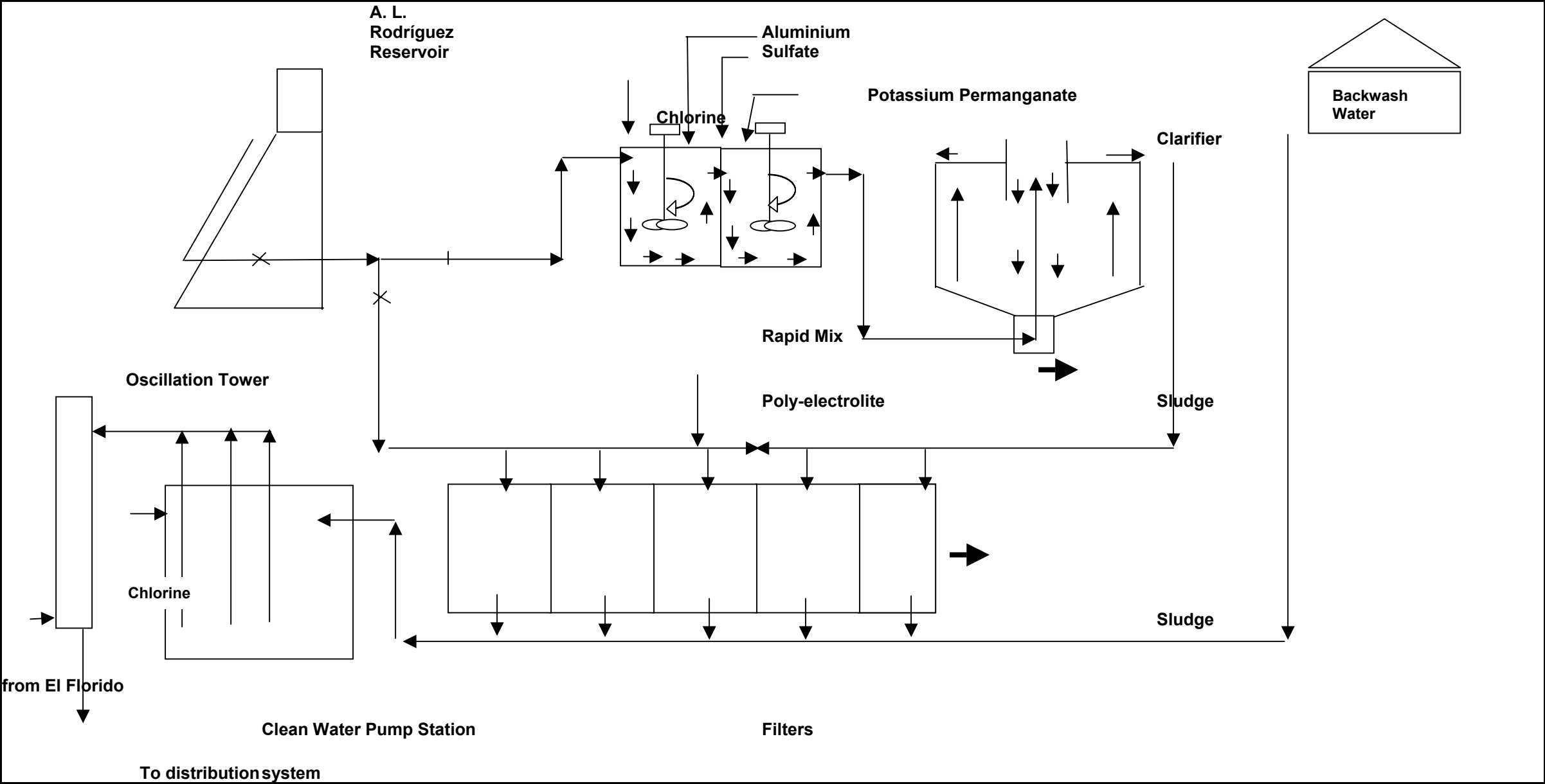


Figure 3-9  
Abelardo L. Rodríguez Water Treatment Plant Flow Diagram

### ***Production History***

Figure 3-10 presents the production of the Rodríguez plant for the period 1998-2001. During those years production was at its maximum level during the summer months and at a minimum in winter.

According to Figure 3-10, during December 1999, January-June 2000, December 2000, and January-March 2001, the plant had no water production due to the low levels of water in the Reservoir.

### ***Treatment Process***

The Abelardo L. Rodríguez Water Treatment Plant is made up of the following processes: pre-chlorination, coagulation, sedimentation, filtration, post-chlorination, treated water reservoir, and pumping station to the distribution network. A summary of the water treatment plant processes is presented in Table 3-5.

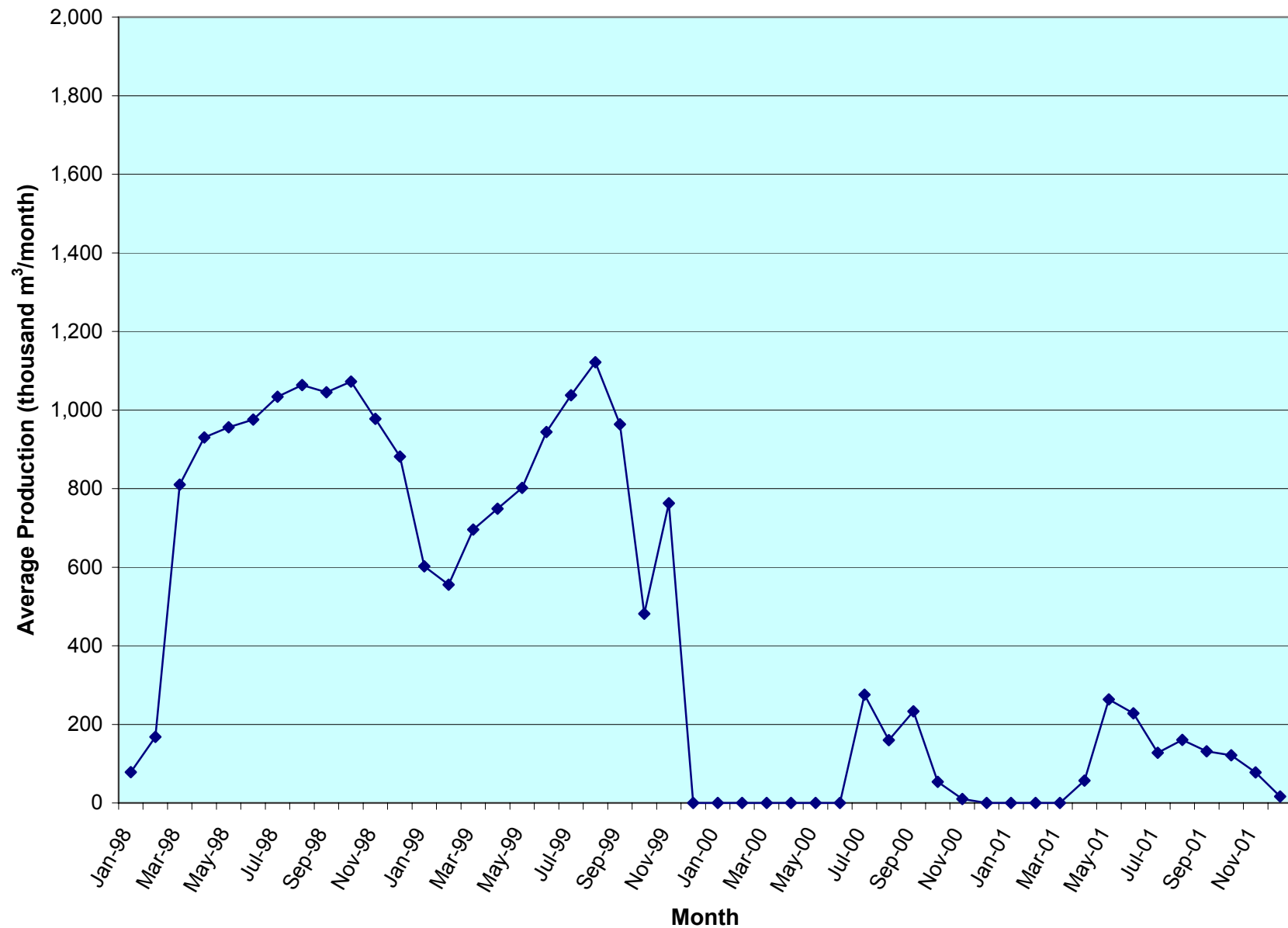


Figure 3-10  
Historical production of Abelardo L. Rodríguez Water Treatment Plant

Table 3-5 Design Criteria for the Abelardo L. Rodríguez Plant			
Operation Starting Year		1975; Expansion 1980	
Capacity in Place	m <sup>3</sup> /s	0.6	
Type of rapid mix		Mixing chamber, with mechanical agitator	
Quantity		2	
Type of flocculator and settler		Upflow Flocculator and Settler	
Quantity of equipment		1	
Flow per unit	l/s	600	
Tank Area	m <sup>2</sup>	669	
Tank Volume	m <sup>3</sup>	4955	
Detention Time	min	137	
Type of filters		Declining rate	
No.		5	
Filtration Rate	m <sup>3</sup> /m <sup>2</sup> /d	329	
Filtration Rate with one filter out of operation (in backwash)	m <sup>3</sup> /m <sup>2</sup> /d	412	
Filter area	m <sup>2</sup>	31.44	
Type of media filter		Dual media (sand and anthracite)	
Depth	cm	25 of sand and 75 of anthracite	
Uniformity Coefficient	mm	xx of sand / 0.9 of anthracite	
Type of backwash		Air and water	
Backwash pumps		XX	
Blower		XX	
Treated Water Storage		1	
No. of Tanks		365	
Capacity	m <sup>3</sup>	10	
Theoretical detention time	min	No	
Baffles			
Backwash Water Recovery and Type		XX	
No.		XX	
No. of filter backwashes per day		XX	
Average volume per filter	m <sup>3</sup>	XX	
Total volume	m <sup>3</sup>	XX	
Type of sludge management		XX	
No.	XX	XX	
Chemicals		Chlorine and/or potassium permanganate	
Chemical Use		XX	
Dose	mg/l	XX	
Type of feeder equipment		XX	
No.		XX	
Capacity		XX	
Storage	m <sup>3</sup>	Xx	
No. of days at average flow		XX	
Chemical Use		Chlorine / Pre-Oxidant Disinfectant	
Dose	mg/l	XX	
Type of feeder		Chlorine Gas	
No.		1 feeder	
Capacity		XX	
Chemical Use		Chlorine / postchlorination	
Dose	mg/l	XX	
Type of feeder		Chlorine Gas	
No.		In service 1	
		XX	
Capacity		XX	
Storage	kg	XX	
No. of days at average flow		XX	

### ***Treated Water Quality***

The quality of treated water for the months April through December is shown in Table 3-6.

<b>Table 3-6 Water Quality - Year 2001 – Average Monthly Results – Effluent from Rodriguez Treatment Plant</b>					
<b>Parameters</b>	<b>Units</b>	<b>NOM 127 SSA1 1994 Modification 2000</b>	<b>Effluent Year 2001</b>		
			<b>Average</b>	<b>Minimum</b>	<b>Maximum</b>
Odor		Odorless	Odorless		
Taste		Tolerable	Tolerable		
Visible Color	CIPT	20 REAL	8	5	10
Turbidity	NTU	5	1.0	0.8	1.4
Aluminum	mg/l Al	0.20	<0.04		
Arsenic	mg/l As	0.05	<0.04		
Total Cyanide	mg/l CN <sup>-</sup>	0.07	<0.015		
Residual Chlorine	mg/l Cl <sub>2</sub>	0.2 - 1.5	1.8	1.1	2.2
Chloride	mg/l Cl	250	174	152	206
Copper	mg/l Cu	2.00	<0.015		
Total Chromium	mg/l Cr	0.05	<0.015		
Detergents	mg/l MBAS	0.50	0.04	0.02	0.09
Total hardness	mg/l CaCO <sub>3</sub>	500	344	320	390
Fluorides	mg/l F	1.50	0.58	0.06	0.75
Total Iron	mg/l Fe	0.30	<0.06	<0.06	0.09
Manganese	mg/l Mn	0.15	0.04	<0.033	0.06
Mercury	mg/l Hg.	0.001	<0.00005		
Nitrates	mg/l N	10.00	1.13	0.08	1.90
Nitrites	mg/l N	1.00	<0.005		
Ammoniac Nitrogen	mg/l N	0.50	0.33	0.08	0.65
pH	PH	6.5 - 8.5	7.72	7.50	8.10
Lead	mg/l Pb.	0.010	<0.007		
Sodium	mg/l Na	200	164	150	180
Total Dissolved Solids	mg/l	1000	872	810	965
Sulfates	mg/l SO <sub>4</sub>	400	309	288	350
Zinc	mg/l Zn.	5.00	<0.015		
Total Coliform Organisms	NMP/100 ML	N/A	<2		
Parameters Analyzed With No Mexican Standard					
Total Alkalinity	mg/l CaCO <sub>3</sub>		136	106	154
Boron	mg/l B		0.34	0.10	0.70
Calcium	mg/l Ca		79	74	91
Conductivity	Usiemens/cm		1,382	1,300	1,510
Chemical Oxygen Demand	mg/l O <sub>2</sub>		9.8	5.0	15.0
Calcium hardness	mg/l CaCO <sub>3</sub>		198	186	228
Magnesium hardness	mg/l CaCO <sub>3</sub>		146	134	162
Total Phosphate	mg/l PO <sub>4</sub>				
Silver	mg/l Ag		<0.07		

<p style="text-align: center;"><b>Table 3-6</b> <b>Water Quality - Year 2001 – Average Monthly Results – Effluent from Rodriguez Treatment Plant</b></p>					
Parameters	Units	NOM 127 SSA1 1994 Modification 2000	Effluent Year 2001		
			Average	Minimum	Maximum
Magnesium	mg/l mg		35	33	39
Silica	mg/l SiO <sub>2</sub>		16	12	31
Anion – Cation Difference	%		0.1	-0.6	0.6

The monthly average water quality results indicate that the water quality complies with the current regulations for potable water. However, we recommend that a more detailed analysis be performed in the future on the effectiveness of the removal of particles and disinfection similar to that discussed for the El Florido.

## Wells

As mentioned earlier, there are three sets of wells, which withdraw from the Río Tijuana, Rosarito, and La Misión Aquifers.

### *Production History*

Figure 3-11 shows the production history for the wells in each of the three aquifers during the years 1998 to 2001. The average production of the wells during this period ranged from 48.3 million gallons/month (183,000 m<sup>3</sup>/month) to 198 million gallons/month (382,000 m<sup>3</sup>/month).

In August 2000, a safe yield study was performed for all the wells, including those not in operation and those that are currently operating (OPE, AFOROS, 2000), with the goal of determining the volume that could be reliably extracted from these aquifers. The results of the study indicated that it would be feasible to extract approximately 12 mgd (528 l/s).

### *Quality of Treated Water*

Section 2.2.4 presents the water quality for the three aquifers. In the well area of La Misión there is a water treatment plant near La Misión Wells with a capacity of 1 mgd (50 l/s), but which is currently not operating. It is currently only used to chlorinate the groundwater before it is sent to Rosarito for distribution. The treatment process would be similar to that used at the Rodríguez Water Treatment Plant.

Water withdrawn from the wells in the Río Tijuana aquifer is pumped directly into the distribution system. Due to high concentrations of iron and manganese found in the water from this source (Wells 44, 13, 14, 17, 3 and Corette), CESPT is building a water treatment plant. This plant, currently under construction, will have the capacity to treat 3 mgd (125 l/s) in its first stage. For the first stage they have installed 8 pressure filters, 7 feet in diameter, with the filtration rate of 15.8 m<sup>3</sup>/m<sup>2</sup>/hr. The second stage will treat another 3 mgd (125 l/s) from the rest of the wells in Río

Tijuana. Potassium permanganate ( $\text{KMnO}_4$ ) will be used in a contact tank to oxidize the metals. From there the oxidized water will be sent to the filters, packed with three different media: sand, anthracite, and zeolite.

### **3.2.2 Operation and Maintenance**

CESPT, through its Operations and Maintenance Division (*Subdirección de Operación y Mantenimiento*, SOM), is the institution responsible for maintaining potable water production facilities for the City of Tijuana and Playas de Rosarito in good condition.

CESPT uses detailed manuals that describe the procedure to follow for each of the activities related to operation and maintenance. They also have established programs and guidelines to provide preventive maintenance at the water treatment plants and wells. Likewise, there are manuals supplied by the equipment suppliers, which describe procedures for operation, maintenance and repair of the most important equipment. CESPT has its own facilities for the maintenance of the electromechanical equipment and has professional and technical staff to carry out the preventive maintenance work. For corrective maintenance, CESPT has workshops where some repairs are done. The repairs that cannot be done in the CESPT workshops are done by outside shops.

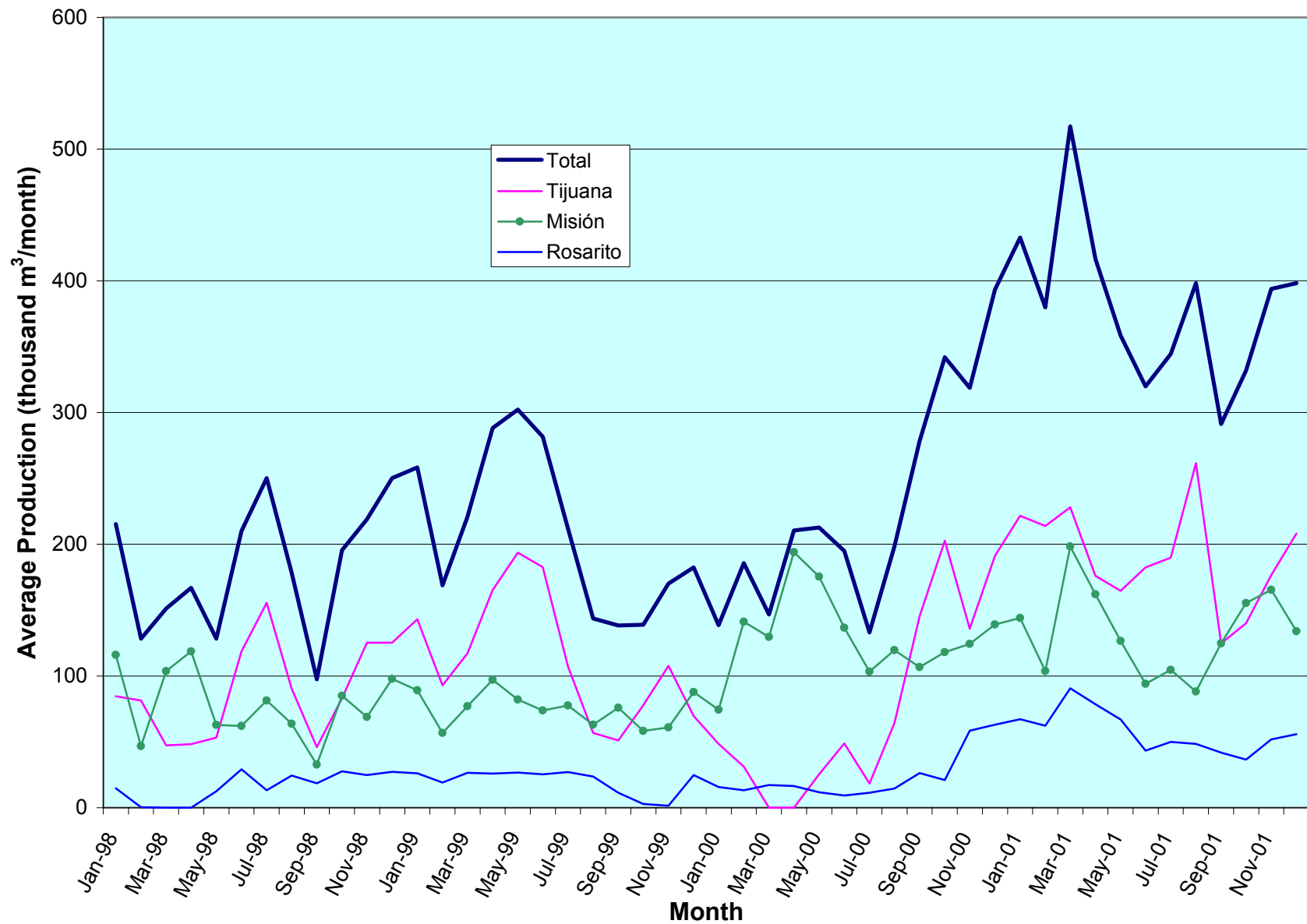


Figure 3-11  
Historical production of wells



The water treatment plants are partially manual and partially automated, with automation being more prevalent. For the operation of the system they also use some telemetry equipment, which operates the level controllers in the master tanks and the opening or closing of valves in the El Florido Water Treatment Plant.

When energy outages occur at the El Florido Water Treatment Plant, the emergency internal combustion plant located at El Florido operates. This generator is used only to provide energy to the pumps and equipment that supply chlorine to the intake and outflow of the plant (pre-chlorination and post-chlorination), as well as for part of the plant lighting.

There are 6 cylinders of 2000 lb. (908 kg) used to feed chlorine into the system. Additionally, there are another 6 in storage and 6 for replacement. Likewise, there are reserve materials in storage that can be used during preventive and corrective maintenance.

The plant is not able to stop production in one part of the module to do preventive or corrective maintenance.

#### ***El Florido Water Treatment Plant***

There are eight employees in charge of the operation of the El Florido Water Treatment Plant. Additionally, there are three people who help with the general maintenance and two people who work on electromechanical maintenance. In case of an emergency requiring more staff, CESPT has an emergency team from the general system that can support the Water Treatment Plant. Likewise, the Department of Electromechanics (Departamento de Electromecánica) has staff that is in charge of preventive maintenance on the equipment throughout the system, including the water plants.

The residual chlorine is monitored by means of a manual sampling every hour. There is no device for continuous monitoring, or alarms that indicate if the parameters do not meet the standards.

The water flow into the plant is measured by two methods. The first method is a velocity sensor with which the volume is later obtained. The second method is through control structures where water levels are measured and the known section of the structure is used to determine the volume.

This flow measurement is used to automatically pace chemical feeds.

#### **Abelardo L. Rodríguez Water Treatment Plant**

The Rodriguez plant has a staff of five in charge of plant operations: One person in charge of electromechanic maintenance and four people who help with the general maintenance of the plant. This personnel is supported by the El Florido maintenance team. In case of emergency, CESPT uses the procedures previously described for El Florido.

### 3.2.3 Current Deficiencies

The limitations or deficiencies identified in the production facilities can be summarized as follows.

#### El Florido Water Treatment Plant

It is highly desirable that water treatment plants do not experience significant fluctuations in flow on a daily basis. Significant or frequent changes in the flow disrupt the treatment process and not allow for its optimization. The main problem in the plants due to great variation in flows such as between 50 mgd (2,200 l/s) and 100 mgd (4,200 l/s). This complicates plant operation, since the staff must continually adjust the system. What is needed is the construction of additional treated water storage to mitigate flow fluctuations and associated adverse impacts in the plant and to establish a regimen of constant operation. Information provided by the Subdivision Office of Operation and Maintenance, Potable Water Department, see Figure 3-7).

Effective operation of the filters requires pretreatment of the water from the source. Unflocculated water can be difficult to treat, unless the water is of high quality and is properly coagulated.

The El Florido Water Treatment Plant produces approximately 95 percent of the water used in Tijuana and Playas de Rosarito. Because this is such a major facility, they should constantly monitor the parameters of water quality (chlorine each hour and turbidity each hour in case of rain and once per shift the rest of the time) to improve reliability in the water system.

Although the water quality from the source is relatively good, pretreatment and filtration can be further optimized to reliably produce turbidities less than 0.5 NTU (95 percent of the time or more), to increase the operation time of the filters between backwashes and overall production efficiency.

CESPT should consider replacing the super-pulsator clarifiers that are not currently functioning. Moreover, the super-pulsators are difficult to operate. This process should be replaced by a more reliable flocculation/sedimentation process.

Another problem is the backwash of the filters in the plant. This process is done with very low rates, which does not ensure the cleaning of the filter beds. The filters are backwashed every eight hours in three phases, with a duration of three minutes for each one. CESPT should evaluate the option of making the backwash process more efficient, changing the regimen and the parameters of the backwash of the filters to save water volume and alleviate the personnel requirements for the operation of the plant.

The main disinfectant used is chlorine gas. One reserve equipment of 2,000 lbs / 24 hrs with a calcium hypochlorite reserve. An optimization study of the plant should also evaluate redundant equipment needs for all the critical processes, such as disinfection.

One potential benefit of improved and more reliable pretreatment is the ability to operate the filters at a higher filter rate to increase overall plant production. If CESPT invests in more effective and reliable pretreatment, and hydraulic capacity limitations are not significant, it is likely that filter rates could be increased significantly without requiring the construction of new filters. This should be further evaluated during a plant optimization study.

The El Florido plant does not have a system to treat the accumulated sludge in the waste backwash water clarifier. The drying beds area has a sludge buildup, requiring renovation and expansion, or even replacement with another system.

Periodically there are problems in the plant with crustaceous microorganisms, which cause the clogging of the filters and result in significant headloss, requiring a more frequent backwash. More effective pretreatment would help to resolve this problem.

There is no effective mechanism to divide the flow equally between the filters, which makes some filters work at higher rates than others. It is recommended that CESPT conduct an optimization study for this treatment plant including an evaluation of the hydraulics throughout the plant, and any potential adverse treatment impacts that can be attributed to hydraulics.

### **Abelardo L. Rodríguez Water Treatment Plant**

The primary problem with this plant is the great variation in the quality of raw water that it receives, especially when the level in the reservoir is very low and the water for the plant is fed from the lower intake. When the water is withdrawn from the lower intake, the turbidity of the water is very high (historical values of more than 1000 NTU), with the occurrence of elevated sulphides ( $H_2S$ ) and manganese (Mn). The manganese problem began after 1996. CESPT has determined that the manganese is of organic origin and is carried to the reservoir by the influents. The plant has problems treating water with a turbidity greater than 100 NTU. Therefore the plates parallel to the settler have been removed, given the flaws in the rivets of the plates.

This plant was not designed with a modular form, so the operation is complicated by flow variation from 0 to 13 mgd (0 to 550 l/s). The sedimentation unit, in this case, operates with a flow that has a very wide range of variation, without the flexibility of maintaining the constant velocity of flow that is essential for this process.

This water treatment plant does not have an auxiliary source of electricity; therefore electrical outages cause emergencies in the plant operations.

There are no design drawings of the plant, detailing the units. Currently there are only sketches.

The automatic filter effluent control valves do not work. These valves require constant manual adjustment, especially during periods of significant flow variations.

We recommend the renovation of the gates to improve the distribution of flow to each filter and to allow the units to be isolated.

The filters are backwashed only with water, but the possibility of adding an air scour step to make the process more efficient and save water flow should be studied.

The plant does not have a system for treating the waste backwash water. It is simply disposed of to the drain.

Additionally, there are problems with the chemical feed equipment at the plant.

## **Wells**

The most significant problem observed with the wells is under-utilization due to a lack of equipment and lack of detailed knowledge of the capacity of the aquifers. Water quality is also an important concern, since high concentrations of turbidity, iron, and manganese have been found in the wells in Río Tijuana, fluorine in the wells in La Misión, and chloride with total dissolved solids in the wells in Rosarito.

There is no information available about other potential contaminants in the aquifers, such as organic compounds. CESPT should consider performing studies to evaluate the water quality of the aquifers and to identify possible sources of contamination in the intake area of the aquifers.

## **3.2.4 Current Planned Projects**

There is one project of change of hollow tank bottoms and chlorination system rehabilitation of the El Florido Water Treatment Plant.

Currently construction is underway on the Monte de Los Olivos Water Treatment Plant, with a capacity of 6 mgd (250 l/s), which will treat water from the wells of the Río Tijuana area. The process focuses on the elimination of manganese and iron.

CESPT indicated they will make changes in the method of injecting chlorine into the filters, in the pre-chlorination and post-chlorination stages, using chlorine fed under vacuum. They will renovate or replace all the re-chlorination facilities, such as the pipelines and pumping equipment.

There are plans to renovate the seven wells that are out of service in the Río Tijuana area and the interconnections that are mentioned in Table 3-7. With these steps CESPT hopes to increase the production of water from 2 mgd (73 l/s) that was extracted in 2001 to 10 mgd (430 l/s) total. Of those 10 mgd (430 l/s) they will treat 6 mgd (250 l/s) in the new Monte de Los Olivos Water Treatment Plant that is under construction.

Table 3-7 Proposed Projects for the Exploitation of Groundwater Through Deep Wells	
Action	Benefit Flow (l/s)
Interconnection of wells on the right bank of the Río Tijuana.	140
Interconnection of wells on the left bank of the Río Tijuana.	130
Renovate and equip wells in the Zona Norte.	40
Drill and equip wells in the Alamar arroyo.	120
<b>Total</b>	<b>430</b>
Source: Recent flow measurements and historical information, Operational Control Department; CESPT, 2002.	

## 3.3 Potable Water System

Our description of the potable water system is based on information provided by CESPT, work meetings and field visits with the staff of the districts in charge of the operation and maintenance of the system and the various sub-divisions, departments, offices and other institutions that have collaborated directly or indirectly by contributing data.

### 3.3.1 Service Area

The construction of the potable water system began in 1948. The first pipelines made of concrete and clay, were installed mainly in the downtown area (zona centro). Some of these pipelines have been substituted by pipe made of other materials, such as PVC, asbesto-concrete and HDPE.

Figure 3-12 shows in five-year periods how potable water services have increased since the fifties. The graphic information covers most of the City of Tijuana and part of Playas de Rosarito, but it does not cover 100 percent of these cities. Additionally, CESPT has a list of what year the network in each *colonia* (neighborhood) was constructed and the material used. This list is compiled annually in the document Pipeline Service Life, which is prepared and updated by the Hydrometry Office (oficina de Hidrometría).

Initially, the City of Tijuana was supplied by a series of wells in the Río Tijuana area; therefore the water distribution system was designed around the supply system, and it included several pumping stations to serve the highest areas of the city. From 1983 to 1985, a major expansion of the potable water system was completed with the construction of the Río Colorado-Tijuana Aqueduct, the El Florido Water Treatment Plant, and two major pipelines along the periphery of the northern and southern areas of the city. As a result of this work, approximately 90 percent of the water users are supplied by gravity.